

# School of Engineering

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## Introduction to vehicle suspension

Mark Sandford

# Why have suspension?

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- ❑ There are two basic problems:
  - ride
  - Handling
  
- ❑ First recognised by?
  
- ❑ Myceneans 1600 - 1200 BC -









# Chariot

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# Why have suspension?

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- There are two basic problems:

- ride
- Handling

- First recognised by?

- Myceneans 1600 - 1200 BC - Compliant Chariot Wheels  
“...used wheels of thin willow or elm, usually with only four spokes. Such a construction was highly springy and resilient and it seems to have enabled these vehicles to have been galloped across the rough ground of the Greek hillsides, where a heavier and more rigid vehicle would have been useless.”



# Why have suspension? Ride

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- ❑ The term suspension comes from the days of horse drawn carriages.
  - ❑ The roads were particularly poor – there was no national highways agency.
  - ❑ The ride was particularly harsh and passengers frequently complained of a sore 'derrier'
  - ❑ A solution was to attach the wheels to a frame and suspend the whole occupant structure by compliant leather straps
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# Suspension

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# Suspension

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# Vehicle isolation - “ride”

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- ❑ Isolation from road imperfections
  - ❑ Predominantly vertical inputs with some longitudinal
  - ❑ Vehicle features to improve ride:
    - motion between wheels and body
    - elastic element to carry weight
    - damping element to dissipate energy
    - linkage to maintain wheel alignment
    - elastomers for medium-frequency isolation
    - soundproofing
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# Handling

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- “Handling” is
    - different to maximum steady state lateral acceleration (“grip”)
    - Slightly awkward to define
  
  - Prodrive’s working definition
    - “a quality of a vehicle that allows or even encourages the operator to make use of all the available grip”
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# Handling

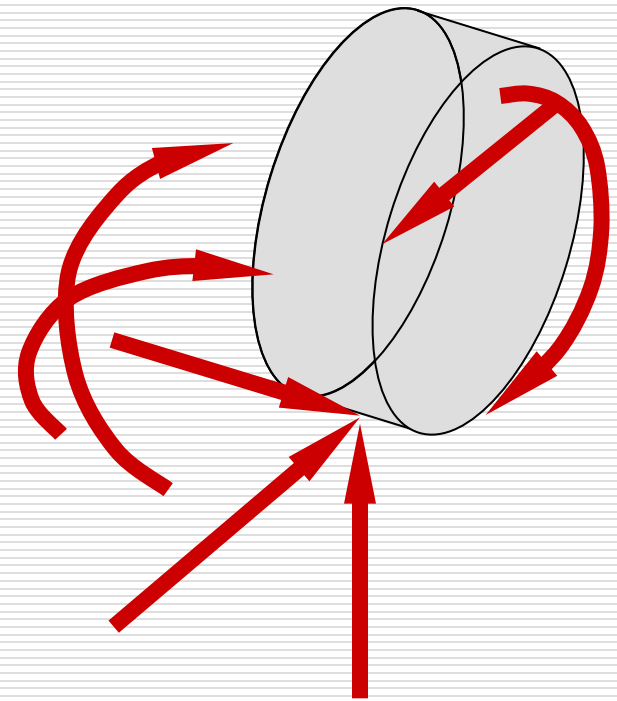
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- Use emotional definitions like:
  - “*Confidence*” (consistency / linearity to inputs)
  - “*Fun*” (high yaw gain, high yaw bandwidth)
  - “*Fluidity*” (yaw damping between manoeuvres)
  - “*Precision*” (disturbance rejection)
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# What must a vehicle suspension linkage system do ?

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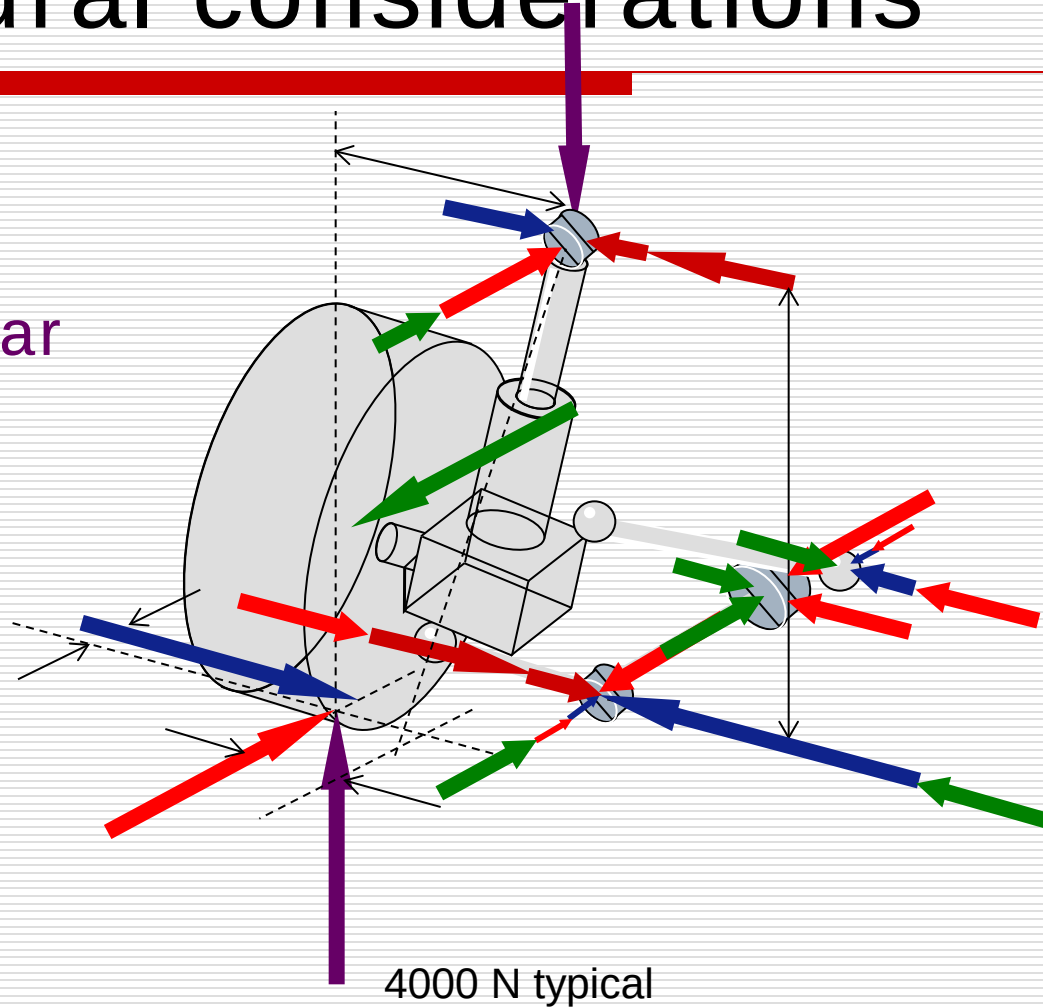
- Suspension hardware must
  - support vehicle weight
  - transmit braking loads from tyre to body
  - transmit lateral loads to body
  - maintain geometry despite applied loads
  - transmit propulsive loads from tyre to body



# Structural considerations

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weight of car  
cornering  
braking  
driving



# What must a vehicle suspension do ?

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- ❑ Suspension hardware must
  - ❑ Allow vertical movement of the wheel and tyre
  - ❑ Minimise changes to wheel alignment during the vertical wheel travel
  - ❑ Allow sufficient angular articulation of the steering wheels
  - ❑ Minimise changes to wheel alignment during the angular wheel travel
  - ❑ “Let nothing steer the wheels but the steering” - Colin Chapman
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